

VERIFICATION OF TRANSLATION

I, Ina Bjerre Larsen, a Danish subject, hereby solemnly and sincerely declare

THAT I am conversant with the Danish and English languages and appointed by the Danish Commerce and Companies Agency, and

THAT to the best of my knowledge and belief the following is a true and accurate translation revised by me of the appended document, viz Danish patent application No: P199901387 as originally filed.

Hellerup, 15 April 2002



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Patent application No.: PA 1999 01387

Filing date: 29 September 1999

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This is to certify the correctness of the following information:

The attached photocopies are true copies of the following documents:

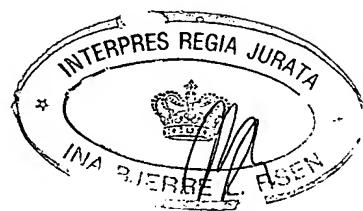
- The specification, claims, abstract and drawings as filed with the application on the filing date indicated above

(Sealed)

The Danish Commerce and Companies Agency
The Danish Patent Office

Taastrup, 03 October 2000

(signed)
Lizzi Vester
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✓

Date: 29 September 1999
Your ref:
Our ref.: P199901172 DK HEB/BOK

A translucent screen comprising a lens system



A translucent screen comprising a lens system

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The present invention relates to a translucent screen comprising a lens system, in particular a Fresnel lens for use in connection with a projection screen, and preferably for use in a rear projection screen featuring such 10 Fresnel lens, and a projection screen with such Fresnel lens. The present invention also relates to methods of manufacturing a translucent screen according to the invention.

15 Projection screens with Fresnel lenses are used in various apparatuses for generating an image that is visible to the viewer; eg rear projection screens are used in connection with the display of radar images, in flight simulators, control rooms, television sets, video monitors, traffic control lights, microfilm readers, video-games and for the showing of films. In such apparatuses 20 an image source arranged behind the screen projects light forwards along a projection axis towards the screen with a view to forming an image on the front of the screen 25 that is visible to the viewer. Typically the screens are rectangular and may have many different dimensions, eg a screen for a microfilm reader will have a diagonal of about 38 cm (15 inches), whereas a screen for a control room or showing film can have a diagonal as large as 30 about 450 cm (180 inches) or more.

A projection screen consists of two functional elements, partly a first element for converting the diverging light beams from the image source to parallel beams, partly a 35 diffusion element that spreads the light from the first element in order to thereby make it visible for a viewer.



In practice the first element consists of a substantially plane Fresnel lens structure and the second element of a plane plate with light-diffusing properties.

5 In principle such screen can be constructed in two ways, partly with a single plane sheet element that is, on the side facing towards the image source, provided with a Fresnel lens, and on the other side with a light-diffusing coating or structure, partly with two plane
10 sheet elements arranged parallel in front of each other, wherein the sheet element most proximate to the image source is provided with a Fresnel lens on that side of the sheet that faces away from the image source, and wherein the sheet element that faces towards the viewer is
15 provided with a light-diffusing coating or structure.

The drawback of the first principle is that a Fresnel lens that faces directly towards the light source has a relatively large transmission loss, typically of about 15
20 to 20 percent. This is due to the fact that a part of the light hits the step faces of the Fresnel lens and are therefor spread in an undesired direction; this phenomenon increases towards the periphery of the lens where the height of the step faces is increased which means that
25 the loss of light is most comprehensive corresponding to the periphery of the screen. An advantage of this configuration is a more simple construction.

30 By the other principle where the Fresnel lens is arranged on that side of the sheet element that faces away from the image source, all light that moves into the plate hits the 'active' Fresnel facets where it is deflected to the above-described parallel batch of beams. Albeit in principle this construction entails an increased efficiency of transmission, the separate light-diffusing
35 plate, however, will cause a loss of transmission when



the light is to pass two more border faces and therefore this type of screen has a transmission effect increase of no more than five to ten percent in all, a value that must in turn take into consideration the more complex 5 construction thereof.

The drawback of both principles is the formation of image disturbances, such as rainbows or double- or multiple- 10 image formation, also designated ghost images. Such phenomena are due to reflections that originate in the step faces at the lens that faces backwards and from the rear face of the Fresnel facets of the forwardly oriented lens, respectively. It applies to both principles that 15 the disturbances are most expressed corresponding to the periphery of the lens where the facets are most steep and have the highest step faces. It also follows from this that the most comprehensive problems occur with lenses with short focal lengths since they are provided with the steepest facets.

20 The problem with internal reflections is well documented and various attempts have been made to counter them.

For instance, US-A-5 477 380 describes that reflections 25 from the rear side of the facets can be attenuated by use of a lens basis containing a refractive diffusion material, but since, on the one hand, the refractive diffusion material is located in correspondence with that surface of the lens base plate that faces away from the lens 30 facets, and on the other hand is very thick (in preferred embodiments the refractive material is distributed almost throughout the entire thickness of the base plate), a powerful diffusion of the incoming light beams will occur before they hit the back of the facets resulting in an 35 unfocused and contrast-poor image. EP-A-0 859 270 discloses a corresponding solution in which the rear of the



screen is coated with a relatively thick layer of a refractive diffusion material.

5 Japanese Patent Abstract 11 072 849 describes how the formation of rainbow phenomena can be reduced by use of a Fresnel lens, wherein the entire lens, ie both lens basis and lens facets, contain a refractive diffusion material. As mentioned above, this will lead to an unfocused as well as contrast-poor image. Also EP-A-0 859 270, US-A-4

10 361 382 and Japanese Patent Abstract 10 293 361 teach screens wherein a refractive diffusion material is distributed corresponding to the entire thickness of the lens.

15 Accordingly it is an object of the invention to provide a screen comprising a surface with a number of lens facets that combine to form a lens system for paralleling diverging light beams (in particular a Fresnel lens structure) and that is suitable for use in or for acting as a

20 projection screen, and wherein the problems with rainbows and double- or multiple-image formation has been reduced to a minimum while maintaining high definition and adequate contrast in image transmission.

25 It is a further object of the invention to provide an effective and simple method of manufacturing projection screens according to the invention.

30 The above and further objects of the invention that will appear from the description that follows of preferred embodiments of the invention are accomplished in that the screen according to the invention comprises a refractive diffusion material distributed in a layer that corresponds essentially to the lens facets as such, and/or a

35 layer immediately behind same. This principle has surprisingly been found to yield a much improved image



transmission compared to the above-described solutions, wherein the light-diffusing agent is found either throughout the entire screen, or in that part of the screen that is most distant from the lens facets. According to a preferred embodiment the refractive diffusing material is distributed primarily in correspondence with the lens facets and in another preferred embodiment, the refractive diffusing material is distributed immediately behind the lens facets.

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According to a second aspect of the invention various methods are provided for effective and simple manufacture of screens according to the invention.

15

The invention will now be explained in further detail with reference to the Figures, wherein

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Figure 1 shows an explanatory configuration of a projection system consisting of an image source and a projection screen;

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Figure 2 is a sectional view through a projection apparatus;

Figure 3 shows the exemplary elements of a Fresnel lens;

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Figure 4 is a sectional view through a Fresnel lens to illustrate the transmission and reflection of a light beam;

Figure 5 is a sectional view through a Fresnel lens to illustrate the transmission of three light beams;

35

Figure 6 is a sectional view through a projection screen according to the present invention illuminated by an image source;



Figure 7 is a sectional view through a projection screen corresponding to an alternative embodiment of the present invention;

5

Before the various preferred embodiments of the present invention are described, an explanation is given with reference to Figures 1 and 2 of the general configuration of the projection assembly of the type that uses a rear projection screen.

10

Figure 1 is a sectional view of a basic configuration of a projection system with a rear projection screen wherein a light source 7 will, via a divergent lens 8, project an image towards a Fresnel lens 9 that deflects the diverging light beams such that they exit from the Fresnel lens as a batch of parallel beams that are all 'normal' to the surface, following which the light is dispersed in the diffusion plate 10 and thereby made visible to a viewer.

15

It should be noted that the diffusion screen could have a lens structure for diffusing the light.

20

As an example of a complete system, Figure 2 shows a vertical section through a projection television set or a video projection apparatus. Such apparatus 1 can be constructed with three separate television tubes, one tube for each primary colour, or as outlined in Figure 1 with one single image source 4 for reproduction of a colour image on the screen 6 via a mirror 5.

25

With reference to Figure 3 the explanatory structures and elements of a Fresnel lens will be explained and, likewise, the nomenclature that will be used in the following description of the preferred embodiments of the present invention will be established.

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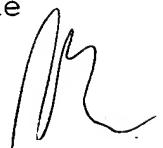
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A Fresnel lens as it lends itself for use in this invention consists of a lens basis or merely a basis in the form of an approximately planar sheet element 30 with a first surface 31 and a second surface 32. The first surface 5 is an approximately planar and smooth surface that defines the reference plane of the lens, whereas the second surface comprises a number of facet structures 33 that combine to form a lens system in the form of a Fresnel lens. Often the term Fresnel lens is used, or merely 10 lens, to designate the entire system of a lens basis with facets. A Fresnel lens can be formed of either a number of linear, mutually parallel facet structures or a number of concentric, annular, in practice circular facet structures.

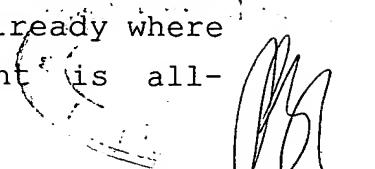
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The individual facet structure consists of the actual facet 34, also designated a facet face, and a step face 35 that meet each other in a facet edge 36. The area between two facet edges is designated a groove, and the deepest 20 point in the groove is designated the groove bottom 37. The area that is delimited by a facet and a step face is designated a facet element 38 or a lens facet. The height of the step face perpendicular to the reference plane is also designated the height of the lens facet or the groove depth. The facets can be plane or curved, but since it is difficult to manufacture a well-defined curvature or a very small facet of typically between 0.05 and 0.35 mm, typically of 0,1 mm, it is desired that the facets are 25 plane. The facets are most steep corresponding to the lens periphery where the facet can have an angle of typically 45° relative to the reference plane. Towards the middle area or centre of the lens, the inclination decreases continuously for the individual facets to become almost parallel with the reference plane. The 30 different angles of the individual facets mean that both the height of the step face as well as the volume of the 35



volume of the individual facet elements decrease towards the middle portion or centre of the lens. The step faces are normally perpendicular to the reference plane, but they can also have another orientation. The bottom of the 5 individual grooves can be in approximately the same plane or in different planes, but for production technical considerations they will usually be in approximately the same plane parallel with the reference plane.

10 The various elements of the screen, ie the facet elements and the plate itself, are made of one or more different matrix materials, wherein a transparent refractive agent, typically in particulate form, can be distributed. The volume or weight percent of the refractive agent can very 15 well exceed the volume or weight percent of the individual matrix material.

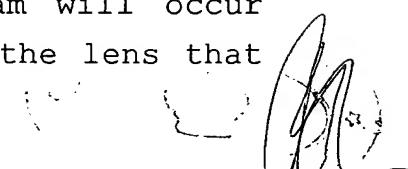
Figure 4 shows how a light beam L3 is transmitted through a clear Fresnel lens 20 with the facets facing away from 20 the image source. The light beam enters the surface 21, is very slightly deflected following which it hits the active facet face 22 of the Fresnel lens where the beam is deflected to the direction L4. A part of the light beam is all-reflected from the facet face 22, following 25 which it passes through the adjacent step face 23, the adjacent facet face 24 to be reflected from the rear 25 of the lens onwards and through the step face 26 and obtains an undesired deflection L5 that results in the above-described phenomena with formation of rainbows and 30 double- and multiple-image formation. The shown light beam L3 with the deflected reflection L5 is only one single example since there are innumerable undesired light beams that will disturb the image, eg as double-image formation. Thus, Figure 5 shows an example wherein three 35 light beams 27 hit a clear Fresnel lens 29. Already where the beams enter the lens, about 5 percent is all- 

reflected, slightly dependent on incidence angle, following which the reflection pattern repeats itself as explained above with reference to Figure 4.

5 For that type of projection screens where the facets of the Fresnel lens face rearwards towards the image source, the formation of rainbows and double- or multiple image formation occurs in a corresponding manner when those of the light beams that enter into the lens through the step
10 faces are deflected.

Figure 6 is a sectional view of an explanatory configuration of a projection system with a rear projection screen in the form of a Fresnel lens according to the present
15 invention, and wherein a light source 7 will, via a divergent lens 8, project an image towards a Fresnel lens
11. It will appear from the figure that that side of the screen, or lens, that faces towards the image source has a Fresnel structure 12 to deflect light beams from the
20 image source, such that the beams are deflected to become a batch of parallel beams with an orientation approximately perpendicular to the screen plane determined by the planar, forwardly oriented surface of this.

25 As will appear from the figure the facet elements of the Fresnel lens and that part of the screen that is most proximate to the facet elements contain a light-diffusing material 13. This light-diffusing material is, within the technical field that relates to projection screens, also
30 designated a diffusion material or a mass spreader. In order to serve as light-diffusing agent the refraction index for the refractive agent must be different from the refraction index for the material in which the refractive agent is situated. It will appear from the figure that
35 the diffusion of the individual light beam will occur from the border face between that part of the lens that



contains the light-diffusing material and that part of the lens that does not contain the light-diffusing material, but this is only to illustrate the principle behind the invention, however, since, of course, the diffusion 5 of light will occur through the entire layer of light-diffusing material.

When the facet elements of the Fresnel lens and optionally 10 that part of the screen that is most proximate to the facet elements contain a light-diffusing material in a thin layer, this will ensure adequate transmission of those of the light beams that are deflected in the facet faces with only little diffusion and thus ensuing good definition and contrast, whereas those of the light beams 15 that are deflected in the step faces of the lens will be exposed to an increased diffusion and thus entail a considerable attenuation of the reflections that are responsible for the formation of shadow images.

20 The thickness of the layer that contains the light-diffusing material can be selected in accordance with the desired suppression of the double-image formation. For instance, the layer may have a thickness that completely or partially corresponds to the height of the step face 25 of the facet elements, or the layer can be so thick that also a part of the lens base plate itself most proximate the facet elements will also contain a refractive material. Depending on the method of manufacture of the lens, it will also be an option only to have refractive material 30 in the lens base plate as such most proximate to the facet elements and hence no refractive material corresponding to the facet elements as such.

Depending on the method of manufacture of the lens, different refractive material can be used for the facet elements 35 and the lens base plate, respectively, and, like- 

wise, the density of the refractive material can be selected differently. If refractive material is used in the lens base plate, the thickness of the layer should be less than 50 percent of the thickness of the base plate, 5 preferably less than 20 percent and most preferably less than 10 percent, but even with a relatively thick layer of refractive material a distribution of this in accordance with the invention, ie most proximate to the facet elements, will result in an improved image with a higher 10 degree of contrast and increased definition than in case the corresponding amount of refractive material was arranged in that part of the lens base plate that faces away from the facet elements as described eg in EP-A-0 859 270 discussed above.

15

An alternative embodiment of the invention is shown in Figure 7 from which it will appear that the screen consists of two plane sheet elements arranged parallel in front of each other, wherein the sheet element 16 most 20 proximate to the image source is provided with a Fresnel lens 19 on that side of the plate that faces away from the image source 7, and where the sheet element 15 that faces towards the viewer is provided with a light-diffusing coating or structure. It will appear from the 25 figure that the refractive material is only located corresponding to the facet elements 17 such that the remaining portion of the Fresnel lens is clear. This is due to the fact that a part of the requisite refractive effect occurs in the image-generating element 15 that consists 30 of a clear supporting element 18 with a diffusion layer 18A with the thickness B closest to the Fresnel lens. As discussed initially an increased light intensity is obtained at the corners when the Fresnel facets face away from the projector 7, but since about 6 percent of the 35 light is also lost during transition to the element 15, the gain is poor, only about 5-10 percent.



Besides, tests have shown that the contrast is considerably improved in a screen corresponding to Figure 6, since only that light in Figure 4 that enters through screen 5 element 18 is reflected from the Fresnel lens surface 19 towards the viewer.

In the following various preferred methods will be described for the manufacture of a screen comprising a 10 Fresnel lens structure according to the present invention. More specifically two different principles of manufacture will be described that aim towards manufacture of relatively large Fresnel lenses on a limited scale and manufacture of relatively small Fresnel lenses on a large 15 scale, respectively.

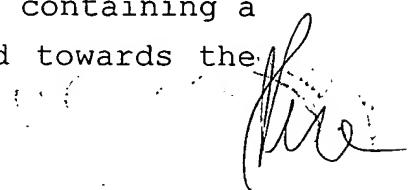
Examples of the light-diffusing agent mentioned in the following could include calcium carbonate, silicon oxide or glass beads having a typical average particle size of 20 between 5 and 25 μm . Calcium carbonate is a very soft material and will therefore not harm the mould, and the same applies to glass beads that are approximately spherical. Glass beads, however, are associated with the drawback that they can be all-reflective. Silicon oxide 25 has extremely good optical properties, but it is a crystalline material with sharp edges with an ensuing increased wear on the mould. The final choice of light-diffusing agent will entail a weighing of advantages and drawbacks for the selected method of manufacture and for 30 the intended use of the lens.

According to the first method a closed mould for a Fresnel lens is arranged approximately horizontally, such that the negative mould for the Fresnel pattern as such 35 constitutes the bottom of the mould and thus faces upwards. The mould is then charged with a curable, fluid



plastics material, eg PMMA or a mixture of PMMA and styrene or other suitable plastics materials with the desired optical and mechanical properties, with which a light-diffusing, translucent material has been admixed, 5 typically in particulate form. Following charging of the mould with the fluid plastics material, it is allowed to rest until the light-diffusing material has precipitated down towards the bottom of the mould, ie has sedimented corresponding to the facet elements. The refractive material 10 will sediment with an approximately constant layer thickness throughout the entire bottom face of the mould, and it follows that depending on the amount of the refractive material the facet elements corresponding to the peripheral portion of the Fresnel lens where the facet 15 elements are deepest - as discussed above - will be completely or partially filled with refractive material. Following sedimentation of the refractive material, the plastics material is cured - eg by application of heat - following which the ready lens can be discharged from the 20 mould.

According to the second method, a mould for a Fresnel lens is arranged substantially horizontally, such that the negative mould for the Fresnel pattern as such constitutes the bottom of the mould and thus it faces upwards. Then a curable, relatively mobile plastics material, eg so-called UV lacquer, is distributed with which a light-diffusing material has been admixed, typically in 25 particulate form. In the next step of the method of manufacture, a plane plate is arranged on top of the mould and it is pressed downwards towards same whereby the mobile plastics material is distributed over the mould and thus fills it corresponding to the facet elements. The planar plate can be a clear plastics plate, or it may be 30 a clear plastics plate coated with a coating containing a refractive material on the that is arranged towards the 35



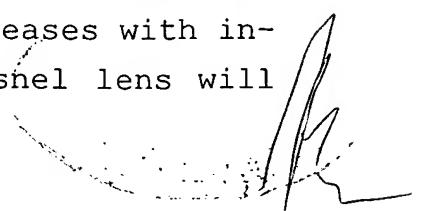
mould, whereby a thin layer of refractive material is generated immediately behind the facet elements of the finished Fresnel lens. Following this, the plastics material is cured, eg by exposure to UV-light applied through 5 the plate, following which the finished lens can be removed from the mould.

According to a variety of the second method, the mould is filled with a clear plastics material without addition of 10 light-diffusing material, such that the entire light-diffusing function is left to the coating of the plate that is, as described above, located immediately behind the facet elements. Hereby it is obtained that the Fresnel mould is not exposed to wear from the light-diffusing 15 material when the liquid plastics material is pressed over the mould.

A lens manufactured in accordance with the first method will thus consist of only a single matrix material, 20 whereas a lens manufactured in accordance with the second method of manufacture can consist of two matrix materials for plate and lens facets, respectively, or three matrix materials for plate, coating and lens facets, respectively.

25 If a light-diffusing material is used, it should have an approximately spherical shape without sharp edges to reduce wear on the mould.

30 Since the previously mentioned problem of double imaging depends either on the inclination of the facet faces or the height of the step edges, the problem of double imaging will grow with increasing inclination on the individual lens facets whereby double imaging increases with increasing radius. As described above a Fresnel lens will



most often be configured with the bottom of the individual grooves being located in the same plane, corresponding to the complementary edges of the mould also being in the same plane. This has the effect that the largest 5 thickness and thus amount of light diffusing material will be located where the facets are the steepest and the step faces are the highest, ie where the problem of double imaging is the most comprehensive.

10 Typical dimensions for a Fresnel lens manufactured in accordance with the above-described methods will be a Fresnel structure with a groove width of between 0.05 and 0.18 mm, a plate with a total thickness of 2-3 mm and a coating, if present, of typically 0.2-0.3 mm.

15 However, it is within the scope of the present invention that the final choice of dimensions and materials will entail a weighing of advantages and drawbacks of the chosen method of manufacture and for the intended use of the 20 lens and hence the desired optical properties.

Claims

1. A translucent screen comprising a first sheet element with a first surface and a second surface substantially parallel with the first surface, wherein the first surface is essentially plane, and wherein the second surface comprises a number of lens facets that combine to form a lens system for paralleling diverging light beams that enter into the sheet element from a first surface, **characterised in that**
the lens facets and/or that part of the first sheet element that is most proximate to the lens facets comprise a refractive material in a concentration that exceeds a concentration of refractive agent in that part of the sheet element that is located most proximate the first surface, and wherein the refractive index for the refractive material is different from the refractive index for the material in which the refractive agent is located.
2. A translucent screen according to claim 1, **characterised in that** the part of the sheet element that is outside the lens facets contains a refractive agent in an even layer in that part of the second sheet element that is most proximate to the lens facets, and wherein said layer has a thickness that is no more than 50 percent of the total screen thickness, preferably no more than 20 percent of the total screen thickness, and most preferably no more than 10 percent of the total screen thickness.
3. A translucent screen according to claim 1, **characterised in that** the lens facets contain a refractive agent; and that that part of the sheet element that is outside the lens facets contains substantially no refractive agent.



4. A translucent screen according to claim 3, **characterised in** that the refractive agent is evenly distributed in each lens facet.

5 5. A translucent screen according to claim 1, **characterised in** that the part of the sheet element that is outside the lens facets contain a refractive agent; and that the lens facets contain essentially no refractive agent.

10 6. A translucent screen according to any one of the preceding claims, **characterised in** that the lens facets consist of a first matrix material with a refractive index that differs from the matrix material(s) that the remainder of the screen consists of.

15 7. A translucent screen according to any one of the preceding claims, **characterised in** that screen comprises a second sheet element arranged in parallel with and on that side of the first sheet that comprises the lens facets; and wherein the second sheet element comprises a refractive agent.

20 8. A translucent screen according to claim 7, **characterised in** that the refractive agent in the second sheet element is distributed in an even layer in that part of the second sheet element that is located most proximate to the lens facets; and wherein the layer has a thickness that is at least twice the highest lens facet.

25 30 9. A method of manufacturing a translucent screen of the type that comprises a sheet element with a first surface and a second surface substantially parallel with the first surface, wherein the first surface is essentially planar, wherein the second surface comprises a number of lens facets that combine to form a lens system for paralleling diverging light beams that enter into the sheet.

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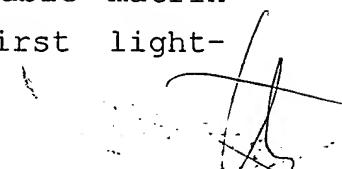


element from the first surface, and wherein the method is **characterised in** comprising the steps of:

- providing a mould with a negative relief of a lens system;
- 5 - positioning the mould substantially horizontally;
- providing a translucent, fluid and curable matrix material, with which is admixed a light-diffusing, preferably granular agent with a refractive index different from the matrix material and with a den-
10 sity that exceeds that of the matrix material;
- charging the mould with the matrix material admixed with the light-diffusing agent;
- allowing the light-diffusing agent to sediment to-
15 wards the negative relief of the mould, such that the concentration of the light-diffusing agent is higher in that part of the matrix material that is located most proximate to the negative relief of the mould;
- curing the matrix material; and
- 20 - removing the cured screen from the mould.

10. A method of manufacturing a translucent screen of the type that comprises a sheet element with a first surface and a second surface substantially parallel with the first surface, wherein the first surface is preferably essentially planar, wherein the second surface comprises a number of lens facets that combine to form a lens sys-
25 tem for parallelizing diverging light beams that enter into the sheet element from the first surface; and wherein the method is **characterised in** comprising the steps of:

- providing a mould with a negative relief of a lens system;
- positioning the mould with the negative relief fac-
35 ing upwards, preferably substantially horizontally;
- providing a translucent, fluid and curable matrix material, with which is admixed a first light-



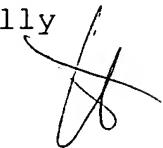
diffusing, preferably granular agent with a refractive index different from the matrix material;

- distributing the matrix material admixed with the first light-diffusing material across the negative relief of the mould;
- providing a sheet element with a first surface and a second surface essentially in parallel with the first surface;
- locating the sheet element with the first surface against the negative relief of the mould on which the matrix material admixed with the first light-diffusing material is distributed;
- pressing the sheet element down against the negative relief of the mould, whereby the matrix material admixed with the first light-diffusing material is distributed over the negative relief of the mould, preferably such that the sheet element essentially abuts on the negative relief over the entire first surface of the sheet element;
- curing the matrix material; and
- removing the cured screen from the mould.

11. A method of manufacturing a translucent screen according to claim 10, **characterised in** that the sheet element corresponding to the first surface comprises a coating with a second light-diffusing agent.

12. A method of manufacturing a translucent screen according to claim 11, **characterised in** that the first and the second light-diffusing agent are different from each other.

13. A method of manufacturing a translucent screen of the type that comprises a sheet element with a first surface and a second surface substantially in parallel with the first surface, wherein the first surface is essentially



planar, wherein the second surface comprises a number of lens facets that combine to form a lens system for paralleling diverging light beams that enter into the sheet element from the first surface, and wherein the method is

5 **characterised in comprising the steps of:**

- providing a mould with a negative relief of a lens system;
- positioning the mould with the negative relief facing upwards, preferably substantially horizontally;
- providing a translucent, fluid and curable matrix material;
- distributing the matrix material across the negative relief of the mould;
- providing a sheet element with a first surface and a second surface substantially in parallel with the first surface, wherein the first surface comprises a coating with a light-diffusing agent;
- positioning the sheet element with the first surface towards the negative relief of the mould on which the matrix material is distributed;
- pressing the sheet element downwards against the negative relief of the mould such that the matrix material is distributed across the negative relief of the mould, preferably such that the sheet element essentially abuts on the negative relief throughout the entire, first surface of the sheet element;
- curing the matrix material; and
- removing the cured screen from the mould.



ABSTRACT

The invention relates to a translucent screen comprising a sheet element with a first surface and a second surface 5 substantially parallel with the first surface, wherein the first surface is essentially planar, and wherein the second surface comprises a number of lens facets that combine to form a lens system for parallelizing diverging light beams that enter into the sheet element from the 10 first surface. The invention is characterised in that the lens facets and/or that part of the first sheet element that is most proximate to the lens facets comprise a refractive material in a concentration that exceeds a concentration of refractive agent in that part of the sheet 15 element that is located most proximate the first surface, and wherein the refractive index for the refractive material is different from the refractive index for the material in which the refractive agent is located.

20 (Figure 6 to be published)



Fig 1.

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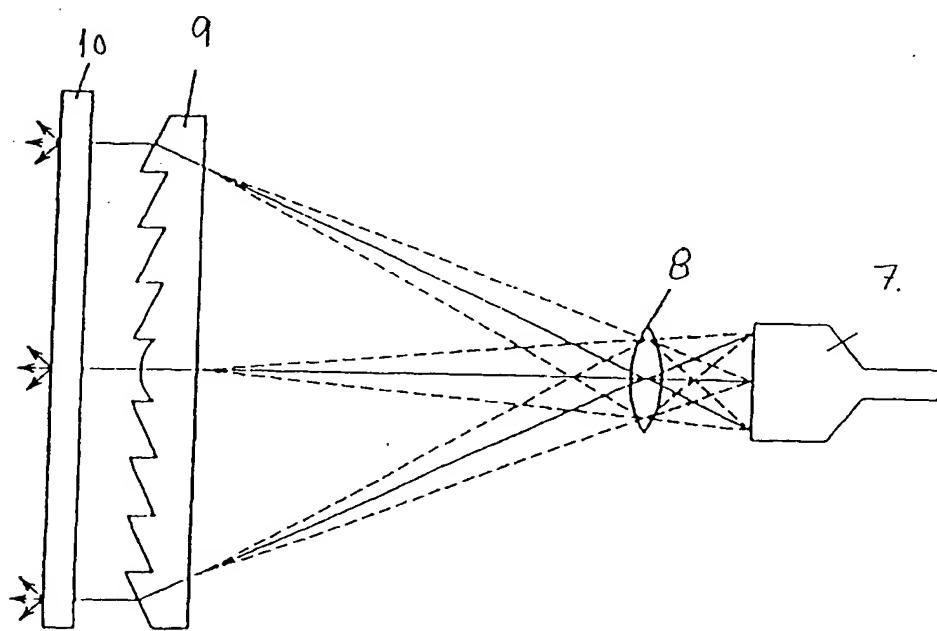
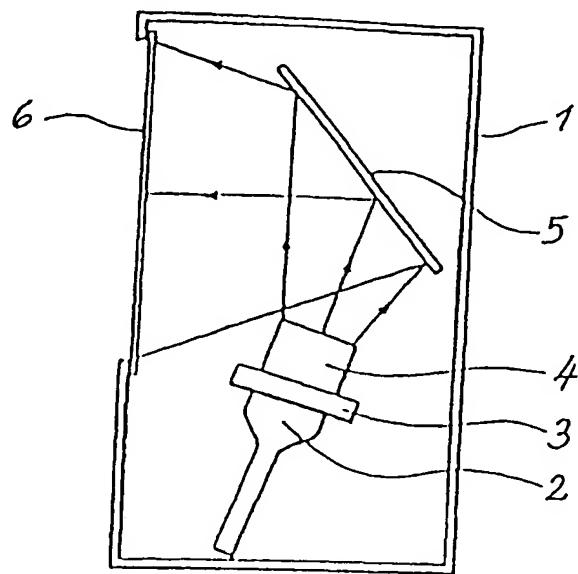
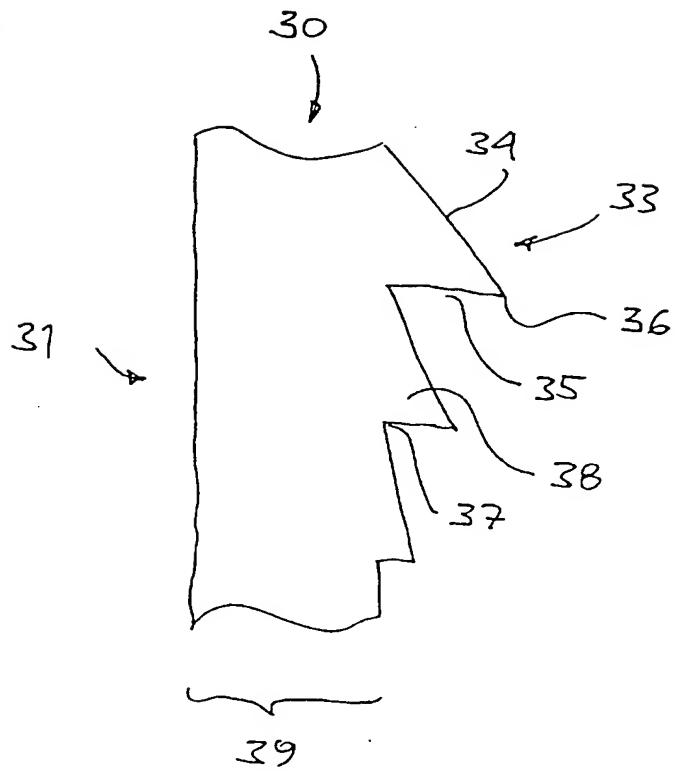


FIG. 2

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Fig. 3



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FIG. 4

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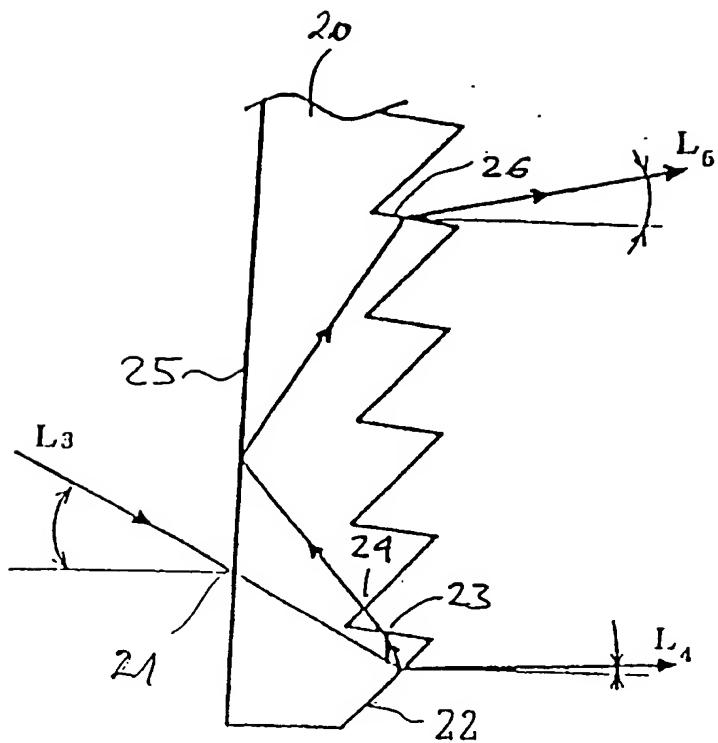
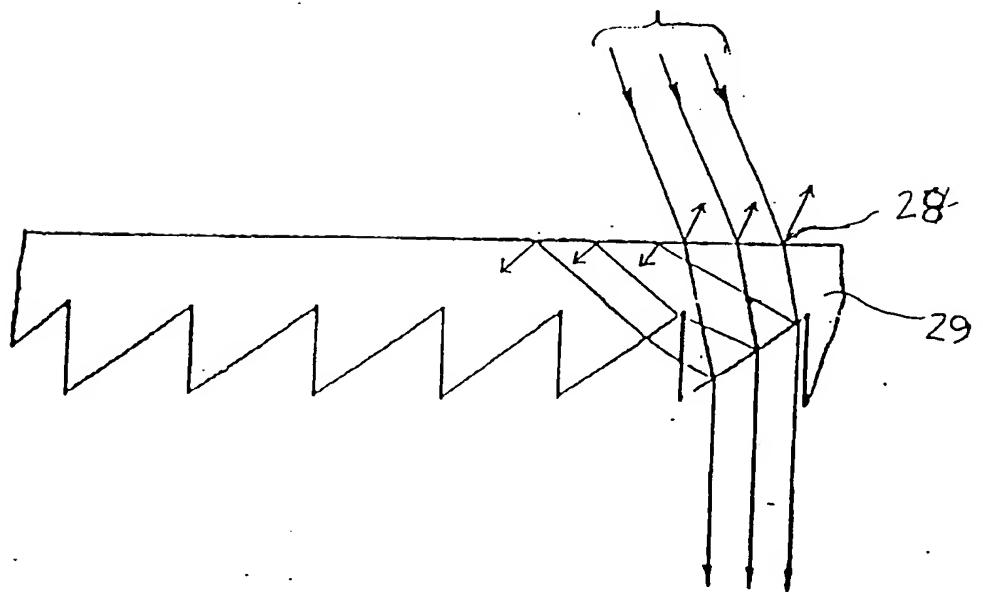


FIG. 5 27



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Fig. 6

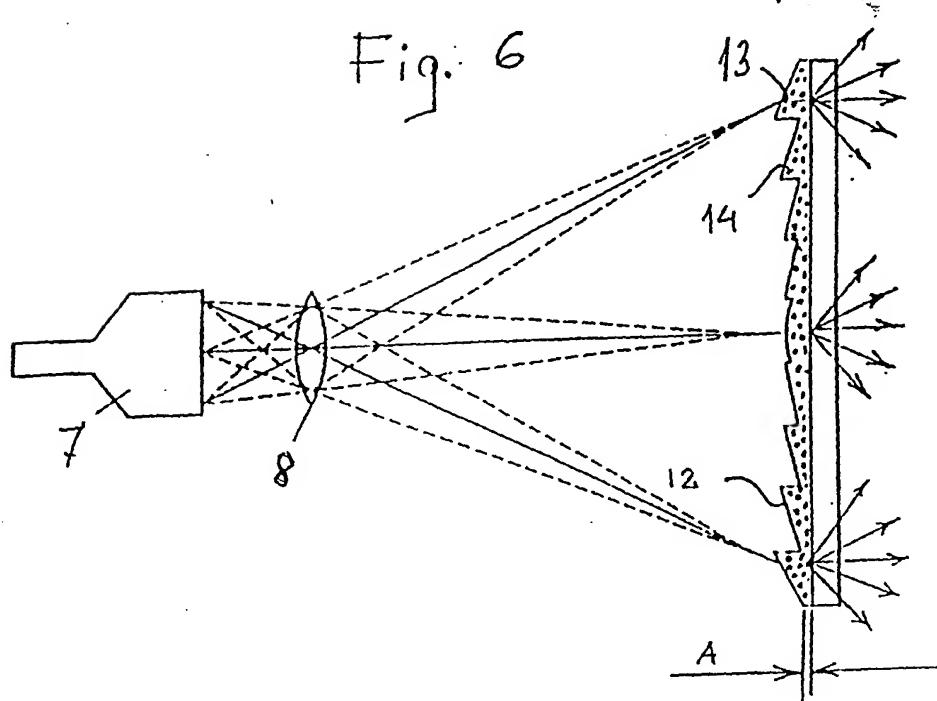
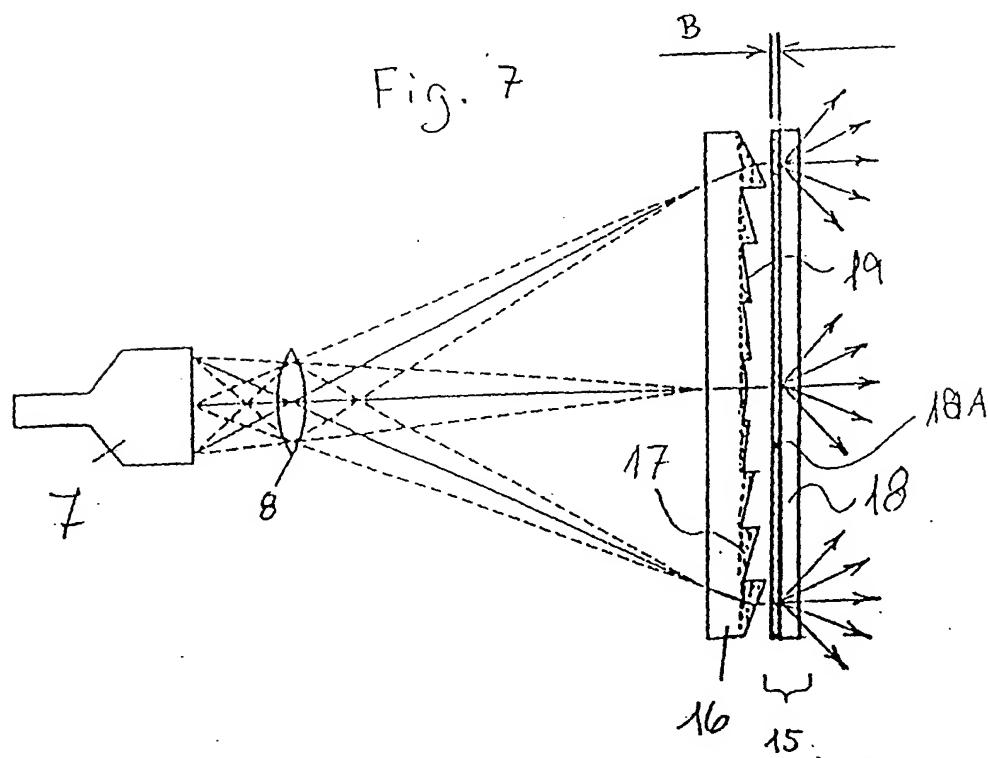


Fig. 7





Kongeriget Danmark

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Indleveringsdag: 29 september 1999

Ansøger: Scan Vision Screen Aps
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Herved bekræftes følgende oplysninger:

Vedhæftede fotokopier er sande kopier af følgende dokumenter:

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Patent- og
Varemærkestyrelsen
Erhvervsministeriet

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Translucent skærm omfattende et linsesystem

Translucent skærm omfattende et linsesystem

Den foreliggende opfindelse angår en translucent skærm omfattende et linsesystem, specielt en fresnellinse til
5 brug i en projektionsskærm, og fortrinsvis til brug i en baglysprojektonsskærm, samt en projektionsskærm med en sådan fresnellinse. Den foreliggende opfindelse angår også fremgangsmåder til fremstilling af en translucent skærm ifølge opfindelsen.

10

Projektonsskærme med fresnellinser anvendes i forskellige apparater til frembringelse af et for betragteren synligt billede, f.eks. anvendes baglysprojektonsskærme i forbindelse med fremvisning af radarbilleder, i flysimulatorer, kontrolrum, fjernsynsapparater, videomonitorer, trafikkontrolls, mikrofilm læsere, videospil og til fremvisning af film. I sådanne apparater projicerer en bag skærmen anbragt billede kilde lys fremad langs en projekti-
15 onskæse imod skærmen med henblik på at danne et for be-
tragteren synligt billede på skærmens forside. Skærmene er typisk rektangulære og kan have mange forskellige di-
mensioner, f.eks. vil en skærm til en mikrofilm læser have en diagonal på omkring 38 cm (15 tommer) hvorimod en skærm til et kontrolrum eller til filmfremvisning kan ha-
20 ve en diagonal så stor som omkring 450 cm (180 tommer).
25

En projektonsskærm består af to funktionelle elementer, dels et første element til at omdanne de divergerende lysstråler fra billede kilden til parallelle stråler, dels
30 et diffusionselement, der spreder lyset fra det første element for derved at synliggøre det for en betragter. I praksis består det første element af en i det væsentlige plan fresnellinsestruktur og det andet element af en plan plade med lysspredende egenskaber.

35

En sådan skærm kan i principippet opbygges på to måder, dels med et enkelt plant, pladeformet element, der på den side, der vender mod billedkilden er forsynet med en fresnellinse og på den anden side med en lysspredende belægning eller struktur, dels med to plane, pladeformede elementer anbragt parallelt foran hinanden, hvor det pladeformede element nærmest billedkilden er forsynet med en fresnellinse på den side af pladen, der vender væk fra billedkilden, og hvor det pladeformede element, der vender mod betragteren er forsynet med den lysspredende belægning eller struktur.

Ulempen ved det første princip er, at en fresnellinse der vender direkte mod billedkilden har et relativt stort transmissionstab, typisk på omkring 15-20 procent. Dette skyldes, at en del af lyset rammer fresnellinsens trin kanter, og derfor spredes i en uønsket retning; dette fænomen tiltager mod linsens periferi, hvor højden på trin kanterne øges, hvorfor lystabet er størst svarende til skærmens periferi. En fordel ved denne udformning er en mere simpel konstruktion.

Ved det andet princip, hvor fresnellinsen er anbragt på den side af det pladeformede element, der vender væk fra billedkilden, rammer alt lys, der bevæger sig ind i pladen, de "aktive" fresnelfacetter, hvor det afbøjes til det ovenfor beskrevne parallelle strålebundt. Selv om denne konstruktion i principippet medfører en højere transmissionseffektivitet vil den separate lysspredende plade dog bevirket et transmissionstab, når lyset skal passere yderligere to grænseflader, hvorfor der for denne skærmtype kun er tale om en transmissionseffekt, der samlet er 5-10 procent højere, hvad der igen skal sammenholdes med den mere komplicerede opbygning.

Ulempen ved begge principper er dannelsen af forstyrrelser i billedet såsom regnbuer og dobbelt- eller flerbillededdannelse, også kaldet spøgelsesbilleder. Disse fænomener skyldes refleksioner, der udgår fra henholdsvis
5 trinkanterne ved den bagudvendte linse, og fra fresnelfaceternes bagflade ved den fremadvendte linse. For begge principper er forstyrrelserne mest udtalt svarende til linsens periferi, hvor facetterne står stejlest og har de højeste trinkanter. Heraf følger også, at de største problemer opstår med linser med kort brændvidde, da disse er
10 forsynet med de stejleste facetter.

Problemet med indre refleksioner er velbeskrevet og er forsøgt imødegået på forskellig måde.

15 For eksempel beskriver US-A-5 477 380 at refleksioner fra faceternes bagside kan dæmpes ved brug af en linsebasis indeholdende et lysbrydende diffusionsmateriale, men da det lysbrydende diffusionsmateriale dels befinner sig
20 svarende til den overflade af linsebasispladen, der vender væk fra linsefacetterne, dels er meget tykt (på foretrukne udførselsformer er det lysbrydende materiale fordele i næsten hele basispladens tykkelse) vil der ske en stærk spredning af de indkomne lysstråler inden disse
25 træffer faceternes bagside, hvilket resulterer i et uskarpt og kontrastfattigt billede. EP-A-0 859 270 viser en tilsvarende løsning, hvor bagsiden af skærmen er belagt med et relativt tykt lag af et lysbrydende diffusionsmateriale.

30 Japanese Patent Abstract 11 072 849 beskriver, hvordan dannelsen af regnbuefænomener kan reduceres ved brug af en fresnellinse, hvor hele linsen, dvs. såvel linsebasis som linsefacetterne, indeholder et lysbrydende diffusionsmateriale. Som nævnt ovenfor vil dette medføre et både
35 uskarpt og kontrastfattigt billede. Også EP-A-0 859 270,

US-A-4 361 382 og Japanese Patent Abstract 10 293 361 viser skærme, hvor et lysbrydende diffusionsmateriale er fordelt svarende til hele linsens tykkelse.

5 Det er følgelig opfindelsens formål at tilvejebringe en skærm omfattende en overflade med et antal linsefacetter, der tilsammen danner et linsesystem til parallelisering af divergerende lysstråler (specielt en fresnellinsestruktur) og som er egnet til brug i en eller som projektorsskærm, og hvor problemerne med regnbuer og dobbelt- eller fler-billeddannelse er nedbragt til et minimum med bevarelse af en høj skarphed og god kontrast ved billedtransmission.

15 Et andet formål med opfindelsen er at tilvejebringe en effektiv og simpel fremgangsmåde til fremstilling af projektorsskærme ifølge opfindelsen.

20 Ovenstående og andre formål for opfindelsen, som vil fremgå af den efterfølgende beskrivelse af foretrukne udførselsformer for opfindelsen, realiseres ved at skærmen ifølge opfindelsen indeholder et lysbrydende diffusionsmateriale fordelt i et lag svarende til selve linsefacetterne og/eller umiddelbart bag disse. Dette princip har 25 overraskende vist at give betydelig bedre billedtransmission end de ovenfor beskrevne løsninger, hvor det lysspredende middel befinder sig i enten hele skærmen eller i den del af skærmen, der befinder sig længst væk fra linsefacetterne. I en fortrukken udførselsform er det 30 lysbrydende diffusionsmateriale fordelt primært svarende til linsefacetterne og i en anden fortrukken udførselsform er det lysbrydende diffusionsmateriale fordelt primært umiddelbart bag linsefacetterne.

I et andet aspekt af opfindelsen tilvejebringes forskellige fremgangsmåder til effektiv og simpel fremstilling af skærme ifølge opfindelsen.

5. Opfindelsen skal herefter forklares nærmere under henvisning til figurerne, hvor

fig. 1 viser en principiel udformning af et projektionssystem bestående af en billedkilde og en projektions-
10 skærm,

fig. 2 viser et snit gennem et projektionsapparat,

15 fig. 3 viser de principielle elementer af en fresnel-
linse,

20 fig. 4 viser et snit gennem en fresnellinse til illustration af en lysstråles transmission og refleksion,

fig. 5 viser et snit gennem en fresnellinse til illustration af tre lysstrålers transmission og refleksion,

25 fig. 6 viser et snit gennem en projektionsskærm ifølge den foreliggende opfindelse belyst af en billedkilde,

fig. 7 viser et snit gennem en projektionsskærm svarende til en anden udførselsform af den foreliggende opfindelse.

30 Før den foreliggende opfindelses forskellige fortrukne udførelsесformer beskrives, gives med henvisning til fig. 1 og 2 en forklaring af den almene udformning af et projektionsanlæg, af typen der anvender en baglysprojektions-
onsskærm.

Fig. 1 viser i snit en principiel udformning af et projekzionssystem med bagsideprojekzionsskærm, hvor en lyskilde 7 via en spredelinse 8 projekterer et billede mod en fresnellinse 9, som afbøjer de divergerende lysstråler, således at de træder ud af fresnellinsen som et bundt af parallele stråler, der alle er "normal" til overfladen, hvorefter lyset spredes i diffusionspladen 10 og derved synliggøres for en betragter. Det skal bemærkes at diffusionsskærm'en kan have en linsestruktur til spredning af lyset.

Fig. 2 viser som eksempel på et komplet system et vertikalt snit gennem et projekzionsfjernsyn eller videoprojektionsapparat. Et sådant apparat 1 kan være konstrueret med tre separate billedrør, et rør for hver grundfarve, eller som antydet i fig. 1 med en enkelt billedkilde 4 til gengivelse af et farvebillede på skærm'en 6 via et spejl 5.

Med henvisning til fig. 3 vil de principielle strukturer og elementer for en fresnellinse blive forklaret ligesom den nomenklatur, der vil blive anvendt i den følgende beskrivelse af de fortrukne udførselsformer for nærværende opfindelse, vil blive fastlagt.

En fresnellinse, som den finder anvendelse i denne opfindelse, består af en linsebasis eller basis i form af et tilnærmelsesvist plant, pladeformet element 30 med en første overflade 31 og en anden overflade 32. Den første overflade er en tilnærmelsesvis plan og glat overflade, der definerer linsens referenceplan, hvorimod den anden overflade omfatter et antal facetstrukturer 33, der tilsammen udgør et linsesystem i form af en fresnellinse. Ofte bruges betegnelsen fresnellinse, eller blot linse, for det samlede system af en linsebasis med facetter. En fresnellinse kan være dannet af enten et antal lineære,

indbyrdes parallelle facetstrukturer eller af et antal koncentriske ringformede, i praksis cirkulære, facetstrukturer.

5 Den enkelte facetstruktur består af den egentlige facet 34, også kaldet en facetflade, og en trinkant 35, der møder hinanden i en facetkant 36. Området mellem to facetkanter benævnes en rille og det dybeste punkt af rillen benævnes rillens bund 37. Det område, der begrænses af en 10 facet og en trinkant benævnes et facetelement 38 eller en linsefacet. Trinkantens højde vinkelret på referenceplanet kaldes også linsefacettens højde eller rillens dybde. Facetterne kan være plane eller krumme, men da det er vanskeligt at fremstille en veldefineret krumning for 15 en meget smal facet på typisk mellem 0,05 og 0,35 mm, typisk på 0,1 mm, tilstræbes det, at facetterne er plane. Facetterne står stejlest svarende til linsens periferi, hvor facetten kan have en vinkel på typisk 45° i forhold til referenceplanet. Ind mod linsens midte eller centrum 20 aftager hældningen for de enkelte facetter kontinuert for at komme næsten i plan med referenceplanet. De forskellige vinkler på de enkelte facetter bevirker, at såvel højden på trinkanten som volumenet af de enkelte facetelementer aftager mod midten eller centrum af linsen. Trinkanterne vil normalt stå vinkelret på referenceplanet, 25 men kan også have en anden orientering. Bunden på de enkelte riller kan ligge i tilnærmelsesvis samme plan eller i forskellige planer, men af fremstillingstekniske årsager vil de normalt ligge i det tilnærmelsesvis samme plan 30 parallelt med referenceplanet.

Skærmens forskellige dele, dvs. facetelementerne og selve pladen er fremstillet i et eller flere forskellige basismaterialer hvori et transparent lysbrydende middel, typisk i partikelform, kan være fordelt. Volumen- eller 35

vægtprocenten af det lysbrydende middel kan godt være større end volumen- eller vægtprocenten for det enkelte basismateriale.

5 Fig. 4 viser hvorledes en lysstråle L3 transmitteres gennem en klar fresnellinse med facetterne vendende væk fra billedkilden. Lysstrålen træder ind i overfladen 21, afbøjes ganske lidt hvorefter den rammer fresnellinsens aktive facetflade 22, hvor strålen afbøjes til retningen 10 L4. En del af lysstrålen totalreflekteres fra facetfladen 22 hvorefter den passerer gennem den hosliggende trinkant 23, den hosliggende facetflade 24 for at blive reflekteret fra bagsiden 25 af linsen frem og gennem trinkanten 26 og får en ønsket afbøjning L5, der resulterer i de 15 ovenfor beskrevne fænomener med dannelse af regnbuer og dobbelt- eller fler-billeddannelse. Den viste lysstråle L3 med den afbøjede refleksion L5 er kun et enkelt eksempel, da der findes uendelig mange ønskede lysstråler som vil forstyrre billede eksempelvis som dobbeltbillede 20 dannelse. Fig. 5 viser således et eksempel hvor tre lysstråler 27 rammer en klar fresnellinse 29. Allerede hvor strålerne træder ind i linsen totalreflekteres ca. 5 %, lidt afhængig af indfaldsvinkel, hvorefter refleksionsmønsteret gentager sig som forklaret ovenfor med henvisning til fig. 4.

For den type af projektionsskærme, hvor fresnellinsens facetter vender bagud mod billedkilden, sker dannelsen af regnbuer og dobbelt- eller fler-billeddannelse på tilsvarende måde, når den del af lysstrålerne, der træder ind i linsen gennem trinkanterne, afbøjes.

Fig. 6 viser i snit en principiel udformning af et projektionssystem med bagsideprojektionsskærm i form af en fresnellinse ifølge den foreliggende opfindelse, og hvor en lyskilde 7 via en spredelinse 8 projekterer et billede

mod en fresnellinse 11. Af figuren fremgår det, at den side af skærmen, eller linsen, som vender mod billedkilden har en fresnelstruktur 12 til at afbøje lysstråler fra billedkilden, således at strålerne afbøjes for at 5 blive til et bundt af parallelle stråler med en retning tilnærmelsesvis vinkelret på skærmens plan bestemt af dennes plane fremadrettede overflade.

10 Som det fremgår af figuren indeholder fresnellinsens facetelementer samt den del af skærmen der ligger nærmest facetelementerne et lysspredende materiale 13. Dette lys- 15 spredende materiale benævnes, indenfor det tekniske område, der beskæftiger sig med projektionsskærme, også for et diffusionsmateriale eller en massespreder. For at fungere som lysspredende middel må brydningsindexet for det lysbrydende middel afvige fra brydningsindexet for det materiale hvor i det lysbrydende middel befinder sig. Af figuren fremgår det, at spredningen af den enkelte lysstråle vil ske fra grænsefladen mellem den del af linsen, 20 der indeholder det lysspredende materiale og den del af linsen, der ikke indeholder lysspredende materiale, men dette er dog kun for at illustrere princippet bag opfindelsen, da lysspredningen selvfølgelig vil ske gennem hele laget af lysspredende materiale.

25 Når fresnellinsens facetelementer samt eventuelt den del af skærmen der ligger nærmest facetelementerne indeholder et lysspredende materiale i et tyndt lag, vil dette sikre en god transmission af de af lysstrålerne, der afbøjes i 30 facetfladerne med kun en ringe spredning og dermed en god skarphed og kontrast til følge, hvorimod de af lysstrålerne, der afbøjes i linsens trinkanter vil udsættes for en større spredning og dermed medføre en væsentlig dæmpning af reflekserne ansvarlig for dannelsen af skyggebiller. 35

Tykkelsen af det lag, der indeholder det lysspredende materiale kan vælges alt afhængig af hvilken undertrykkelse af dobbeltbilledannelsen der ønskes. For eksempel kan

5 laget have en tykkelse, der helt eller delvis svarer til højden af facetelementernes trinkant eller laget kan være så tykt, at også en del af selve linsebasispladen nærmest facetelementerne indeholder et lysbrydende materiale. Afhængig af fremstillingsmetoden for linsen vil det også

10 være muligt kun at have lysbrydende materiale i selve linsebasispladen nærmest facetelementerne og altså intet lysbrydende materiale svarende til selve facetelementerne.

15 Afhængig af fremstillingsmetoden for linsen vil der kunne anvendes forskelligt lysbrydende materiale for henholdsvis facetelementerne og linsebasispladen, ligesom tætheden af det lysbrydende materiale i de to områder kan vælges forskelligt. Hvis der anvendes lysbrydende materiale

20 i linsebasispladen bør tykkelsen af laget være mindre end 50% af tykkelsen af basispladen, fortrinsvis mindre end 20% og mest fortrinsvis mindre end 10%, men selv med et relativt tykt lag af lysbrydende materiale vil en fordealing af dette i følge opfindelsen, dvs. nærmest facetelementerne, resultere i et bedre billede med højere kontrast og større skarphed, end hvor den tilsvarende mængde lysbrydende materiale var anbragt i den del af linsebasispladen, der vender væk fra facetelementerne som beskrevet for eksempel i EP-A-0 859 270 diskuteret ovenfor.

25 En anden udførselsform af opfindelsen vises i fig. 7, hvor det fremgår, at skærmen består af to plane, pladeformede elementer anbragt parallelt foran hinanden, hvor det pladeformede element 16 nærmest billedkilden er forsynet med en fresnellinse 19 på den side af pladen, der vender væk fra billedkilden 7, og hvor det pladeformede

30

35

element 15, der vender mod betragteren er forsynet med en lysspredende belægning eller struktur. Det fremgår af figuren, at det lysbrydende materiale kun er placeret svarende til facetelementerne 17 således at den øvrige del

5 af fresnellinsen 16 er klar. Dette skyldes, at en del af den nødvendige lysbrydning sker i det billeddannende element 15, som består af et klart, bærende element 18 med et diffusionslag 18A med tykkelsen B nærmest fresnellinsen. Som indledningsvis diskuteret opnås der forøget lys-

10 styrke i hjørnerne når fresnelfacetterne vender væk fra projektoren 7, men da der samtidig tabes omkring 6% af lyset ved overgang til elementet 15 er gevinsten ringe, kun omkring 5-10%.

15 Endvidere viser testforsøg at kontrasten er væsentlig bedre i en skærm svarende til fig. 6 da kun det lys i fig. 4, som træder ind gennem skærmelement 18 reflekteres tilbage fra fresnellinsens overflade 19 ud til iagttageren.

20 I det følgende vil der blive beskrevet forskellige foretrukne fremgangsmåder til fremstilling af en skærm omfattende en fresnellinsestruktur ifølge nærværende opfindelse. Nærmere bestemt vil der blive beskrevet to forskellige fremstillingsprincipper der sigter mod henholdsvis fremstilling af relativt store fresnellinser i få eksempler og fremstilling af relativt små fresnellinser i masseproduktion.

25

30 Det lysspredende middel, der nævnes i det følgende, kan eksempelvis være kalciumkarbonat, siliciumoxid eller glasperler med en typisk gennemsnitlig partikelstørrelse på mellem 5 og 25 mikrometer. Kalciumkarbonat er et meget blødt materiale og vil derfor skåne formen, ligesom glasperler, der er tilnærmedesvis sfæriske. Glasperler har

35 dog den ulempe, at de kan være totalreflekterende. Sili-

ciumoxid har særdeles gode optiske egenskaber, men er et krystallinsk materiale med skarpe kanter, hvad der vil medføre et større slid på formen. Det endelige valg af det lysspredende middel vil medføre en afvejning af fordele og ulemper for den valgte fremstillingsmetode og for den tiltænkte anvendelse af linsen.

Ifølge den første fremgangsmåde placeres en støbeform for en fresnellinse i tilnærmelsesvis horisontalt leje således at negativformen for selve fresnelmønsteret udgør bunden af formen og dermed vender opad. Formen ifyldes herefter et hærdbart, flydende plastmateriale, for eksempel PMMA eller en blanding af PMMA og styren eller andre velegnede plastmaterialer med de ønskede optiske egenskaber, hvori er iblandet et lysspredende translucent materiale, typisk i partikelform. Efter at formen er blevet fyldt med det flydende plastmateriale henstår denne, indtil det lysspredende materiale er sunket ned mod formens bund, dvs. har sedimenteret sig svarende til facetelementerne. Det lysbrydende materiale vil sedimentere med en tilnærmelsesvis konstant lagtykkelse over hele formens bundflade, så afhængig af mængden af det lysbrydende materiale vil facetelementerne svarende til fresnellinsens perifere del, hvor facetelementerne er dybest som diskuteret ovenfor, blive helt eller delvist fyldt med lysbrydende materiale. Efter at det lysbrydende materiale er sedimenteret, hærdes plastmaterialet, for eksempel med varme, hvorefter den færdige linse kan udtages af formen.

Ifølge den anden fremgangsmåde placeres en støbeform for en fresnellinse i tilnærmelsesvis horisontalt leje således at negativformen for selve fresnelmønsteret udgør bunden af formen og dermed vender opad. Herefter fordeles et hærdbart, tyndtflydende plastmateriale, for eksempel såkaldt UV-lak, hvori er iblandet et lysspredende materiale, typisk i partikelform. Som næste trin i fremstil-

lingsprocessen placeres en plan plade ovenpå formen og presses ned mod denne, hvorved det tyndtflydende plastmateriale fordeles over formen og derved fylder denne op svarende til facetelementerne. Den plane plade kan være
5 en klar kunststofplade, eller den kan være en klar kunststofplade belagt med en coatning indeholdende et lysbrydende materiale på den side, der lægges ned mod formen, hvorved der skabes et tyndt lag af lysbrydende materiale umiddelbart bag facetelementerne i den færdige fresnel-
10 linse. Herefter hærdes plastmaterialet, for eksempel med UV-lys appliceret gennem pladen, hvorefter den færdige linse kan udtages af formen.

I en variant af den anden fremgangsmåde ifyldes formen et
15 klart plastmateriale uden tilsetning af lysspredende materiale, således at hele den lysspredende funktion overlades til pladens coatning, der som ovenfor beskrevet befinder sig umiddelbar bag facetelementerne. Herved opnås, at fresnelformen ikke udsættes for slitage fra det lys-
20 spredende materiale, når det tyndtflydende plastmateriale presses ud over formen.

En linse fremstillet efter den første fremgangsmåde vil
således bestå af kun et enkelt basismateriale, hvorimod
25 en linse fremstillet efter den anden fremgangsmåde kan bestå af to basismaterialer for henholdsvis plade og linsefacetter, eller tre basismaterialer for henholdsvis plade, coatning og linsefacetter.
30 Hvis der anvendes lysspredende materiale, bør dette have en tilnærmedesvis sfærisk form uden skarpe kanter for ikke at slide unødig på formen.

Da det tidligere omtalte problem med dobbelt billeddannelsel af afhængig af enten hældningen på facetfladerne
35 eller højden på trinkanterne, vil problemet med dobbelt

billeddannelse vokse med voksende hældningsvinkel på de enkelte linsefacetter, således at dobbelt billeddannelse vokser med voksende radius. Som ovenfor beskrevet vil en fresnellinse oftest være udformet med bunden af de enkelte riller liggende i det samme plan, svarende til at de komplementære kanter på støbeformen også ligger i samme plan. Dette bevirker, at den største tykkelse og dermed mængde af lysspredende materiale vil befinde sig hvor facetterne står stejlest og trinkanterne er højest, dvs. at lysspredningen og dermed dæmpningen er størst, der hvor problemet med dobbeltbilleddannelse er størst.

Typiske dimensioner for en fresnellinse fremstillet efter den ovenfor beskrevne anden fremgangsmåde vil være en fresnelstruktur med en rillebredde på mellem 0,05 og 0,18 mm, en plade med en samlet tykkelse på 2-3 mm og en coating, hvis tilstede, på 0,2-0,3 mm.

Det ligger dog inden for rammerne af denne opfindelse, at det endelige valg af dimensioner vil medføre en afvejning af fordele og ulemper for den valgte fremstillingsmetode og for den tiltænkte anvendelse af linsen og dermed de ønskede optiske egenskaber.

29 SEP. 1999

Patentkrav:

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1. Translucent skærm omfattende et første pladeformet element med en første overflade og en anden overflade i det væsentlige parallel med den første overflade, hvor den første overflade fortrinsvis er i det væsentlige plan, og hvor den anden overflade omfatter et antal linsefacetter der tilsammen danner et linsesystem til parallelisering af divergerende lysstråler, der træder ind i det pladeformede element fra den første overflade,
15 kendte tegnet ved, at

linsefacetterne og/eller den del af det første pladeformede element der befinder sig nærmest linsefacetterne indeholder et lysbrydende middel i en koncentration større end en koncentration af lysbrydende middel i den del af det pladeformede element der befinder sig nærmest den første overflade, og hvor brydningsindexet for det lysbrydende middel afviger fra brydningsindexet for det materiale hvori det lysbrydende middel befinder sig.

25 2. Translucent skærm ifølge krav 1, kendte tegnet ved, at den del af det pladeformede element der ligger udenfor linsefacetterne indeholder et lysbrydende middel i et jævnt lag i den del af det andet pladeformede element der befinder sig nærmest linsefacetterne 30 og hvor laget har en tykkelse der er højest 50% af den samlede skærmtykkelse, fortrinsvis højest 20% af den samlede skærmtykkelse, og mest fortrinsvis højest 10% af den samlede skærmtykkelse.

35 3. Translucent skærm ifølge krav 1, kendte tegnet ved, at linsefacetterne indeholder et lys-

brydende middel, og ved at den del af det pladeformede element der ligger udenfor linsefacetterne i det væsentlige intet lysbrydende middel indeholder.

5 4. Translucent skærm ifølge krav 3, kendeteget ved, at det lysbrydende middel er jævnt fordelt i hver linsefacet.

10 5. Translucent skærm ifølge krav 1, kendeteget ved, at den del af det pladeformede element der ligger udenfor linsefacetterne indeholder et lysbrydende middel, og ved at linsefacetterne i det væsentlige intet lysbrydende middel indeholder.

15 6. Translucent skærm ifølge ethvert af de foregående krav, kendeteget ved, at linsefacetterne består af et første basismateriale med et brydningsindex der er forskelligt fra det eller de basismaterialer som resten af skærmen består af.

20 7. Translucent skærm ifølge ethvert af de foregående krav, kendeteget ved, at skærmen omfatter et andet pladeformet element anbragt parallelt med og på den side af den første plade der omfatter linsefacetterne, og hvor det andet pladeformede element omfatter et lysbrydende middel.

30 8. Translucent skærm ifølge krav 7, kendeteget ved, at det lysbrydende middel i det andet pladeformede element er fordelt i et jævnt lag i den del af det andet pladeformede element der befinder sig nærmest linsefacetterne og hvor laget har en tykkelse der er mindst det dobbelte af den højeste linsefacet.

35 9. Fremgangsmåde til fremstilling af en translucent skærm af den type der omfatter et pladeformet element med

en første overflade og en anden overflade i det væsentlige parallel med den første overflade, hvor den første overflade fortrinsvis er i det væsentlige plan, hvor den anden overflade omfatter et antal linsefacetter der sammen danner et linsesystem til parallellisering af divergerende lysstråler, der træder ind i det pladeformede element fra den første overflade, og hvor fremgangsmåden er kendte tegnet ved at omfatte trinene:

- fremskaffe en form med et negativrelief af et linsesystem,
- anbringe formen i det væsentlige horisontalt,
- fremskaffe et translucent flydende og hærdbart basismateriale, hvori er iblandet et lysspredende fortrinsvis granulært middel med et brydningsindex forskelligt fra basismaterialet og med en vægtfyldte større end basismaterialets,
- fylde formen med basismaterialet iblandet det lysspredende middel,
- lade det lysspredende middel sedimentere mod formens negativrelief således at koncentrationen af det lysspredende middel er højere i den del af basismaterialet der befinder sig nærmest formens negativrelief,
- hærde basismaterialet, og
- fjerne den hærdede skærm fra formen.

25

10. Fremgangsmåde til fremstilling af en translucent skærm af den type der omfatter et pladeformet element med en første overflade og en anden overflade i det væsentlige parallel med den første overflade, hvor den første overflade fortrinsvis er i det væsentlige plan, hvor den anden overflade omfatter et antal linsefacetter der sammen danner et linsesystem til parallellisering af divergerende lysstråler, der træder ind i det pladeformede element fra den første overflade, og hvor fremgangsmåden er kendte tegnet ved at omfatte trinene:

- fremskaffe en form med et negativrelief af et linsesystem,
- anbringe formen med negativrelieffet vendende opad, fortrinsvis i det væsentlige horisontalt,

5 - fremskaffe et translucent flydende og hærdbart basismateriale, hvori er iblandet et første lysspredende fortrinsvis granulært middel med et brydningsindex forskelligt fra basismaterialet,

- fordele basismaterialet iblandet det første lys-
10 spredende middel ud over formens negativrelief,
- fremskaffe et pladeformet element med en første overflade og en anden overflade i det væsentlige parallel med den første overflade,
- placere det pladeformede element med den første
15 overflade mod formens negativrelief hvorpå basismaterialet iblandet det første lysspredende middel er fordelt,
- trykke det pladeformede element ned mod formens negativrelief således at basismaterialet iblandet det første lysspredende middel fordeles over formens negativ-
20 relief, fortrinsvis således at det pladeformede element i det væsentlige ligger an mod negativrelieffet over hele det pladeformede elements første overflade,
- hærde basismaterialet, og
- fjerne den hærdede skærm fra formen.

25

11. Fremgangsmåde til fremstilling af en translucent skærm ifølge krav 10, kendtegnet ved, at det pladeformede element svarende til den første overflade omfatter en belægning med et andet lysspredende middel.

30

12. Fremgangsmåde til fremstilling af en translucent skærm ifølge krav 11, kendtegnet ved, at det første og det andet lysspredende middel er forskelligt.

35 13. Fremgangsmåde til fremstilling af en translucent skærm af den type der omfatter et pladeformet element med

en første overflade og en anden overflade i det væsentlige parallel med den første overflade, hvor den første overflade fortrinsvis er i det væsentlige plan, hvor den anden overflade omfatter et antal linsefacetter der sammen danner et linsesystem til parallellisering af divergerende lysstråler, der træder ind i det pladeformede element fra den første overflade, og hvor fremgangsmåden er kendte gne t ved at omfatte trinene:

- fremkaffe en form med et negativrelief af et linsesystem,
- anbringe formen med negativrelieffet vendende opad, fortrinsvis i det væsentlige horisontalt,
- fremkaffe et translucent, flydende og hærdbart basismateriale,
- fordele basismaterialet ud over formens negativrelief,
- fremkaffe et pladeformet element med en første overflade og en anden overflade i det væsentlige parallel med den første overflade, hvor den første overflade omfatter en belægning med et lysspredende middel,
- placere det pladeformede element med den første overflade mod formens negativrelief hvorpå basismaterialet er fordelt,
- trykke det pladeformede element ned mod formens negativrelief således at basismaterialet fordeles over formens negativrelief, fortrinsvis således at det pladeformede element i det væsentlige ligger an mod negativrelieffet over hele det pladeformede elements første overflade,
- hærde basismaterialet, og
- fjerne den hærdede skærm fra formen.

Modtaget PD
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SAMMENDRAG:

Opfindelsen vedrører en translucent skærm omfattende et første pladeformet element med en første overflade og en anden overflade i det væsentlige parallel med den første overflade, hvor den første overflade fortrinsvis er i det væsentlige plan, og hvor den anden overflade omfatter et antal linsefacetter der tilsammen danner et linsesystem til parallelisering af divergerende lysstråler, der træder ind i det pladeformede element fra den første overflade. Opfindelsen er ejendommelig ved at linsefacetterne og/eller den del af det første pladeformede element, der befinder sig nærmest linsefacetterne, indeholder et lysbrydende middel i en koncentration større end en koncentration af lysbrydende middel i den del af det pladeformede element, der befinder sig nærmest den første overflade, og hvor brydningsindexet for det lysbrydende middel afviger fra brydningsindexet for det materiale hvori det lysbrydende middel befinder sig.

Figur 6.

Modtaget PD
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Fig 1.

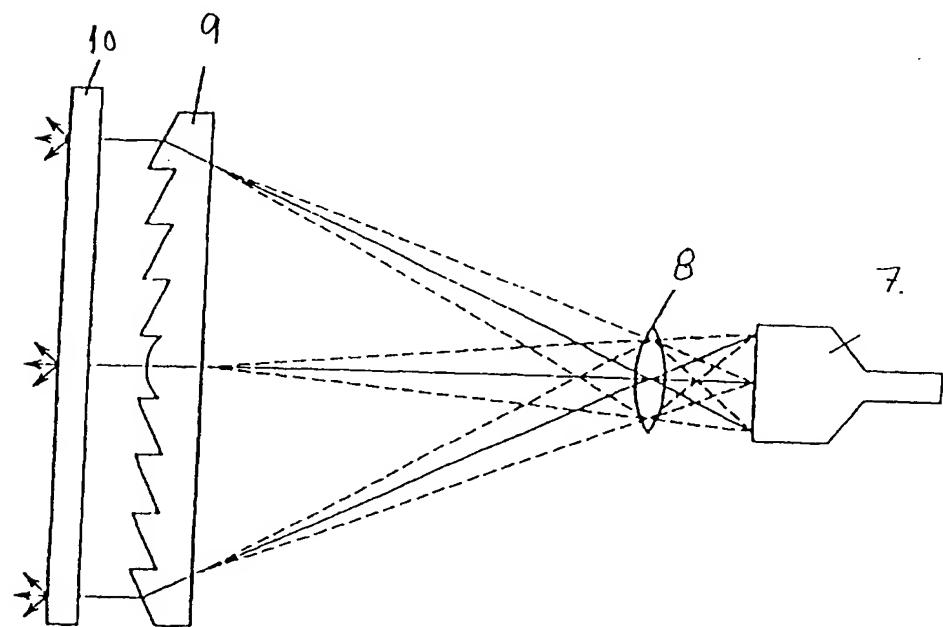
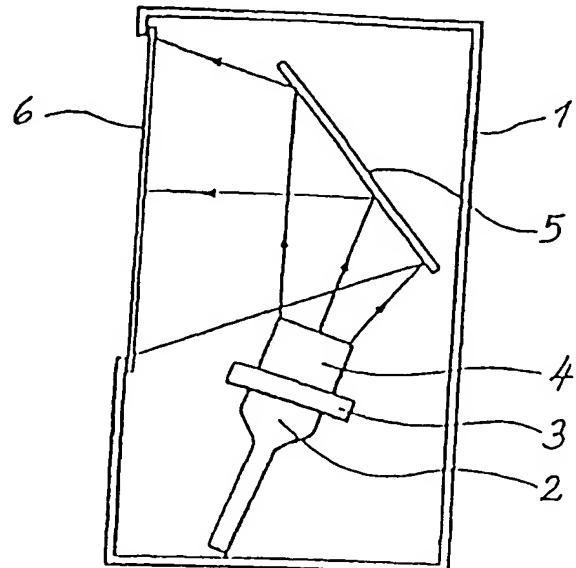


FIG. 2

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Fig. 3

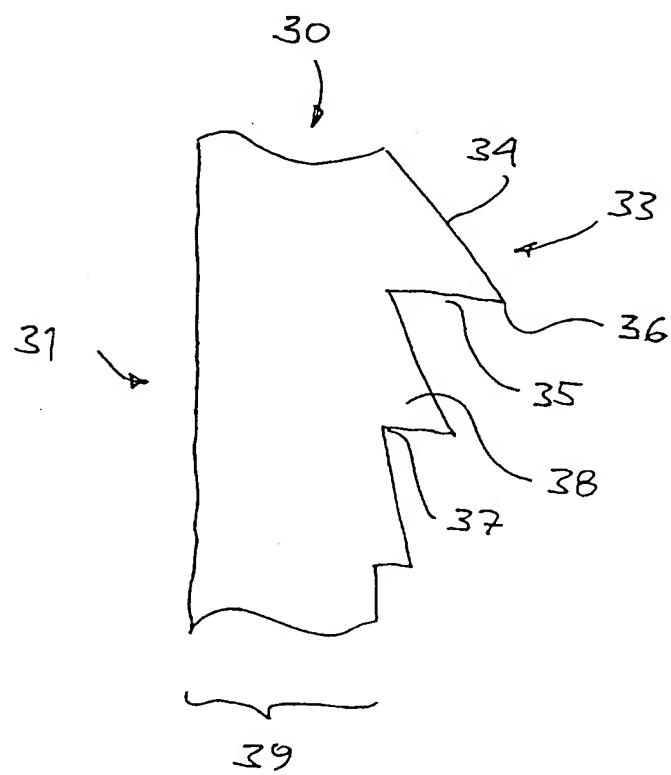


Fig. 4

Modtaget PD
29 SEP. 1999

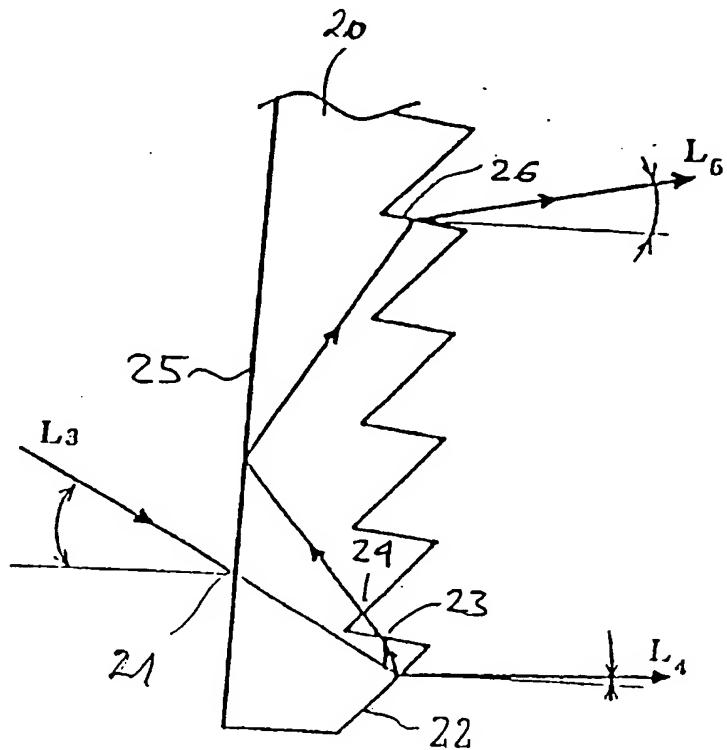
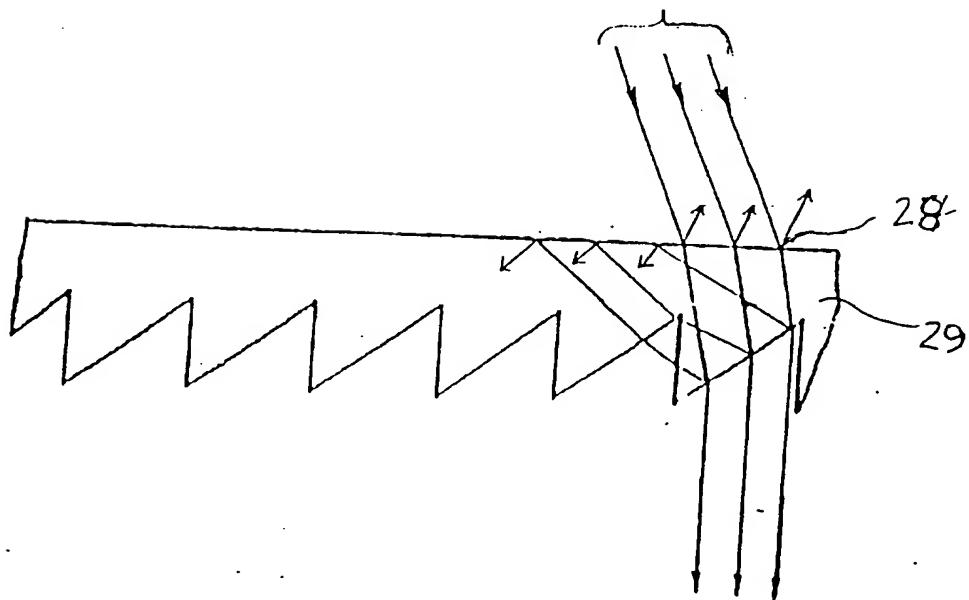


FIG. 5 27



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Fig. 6

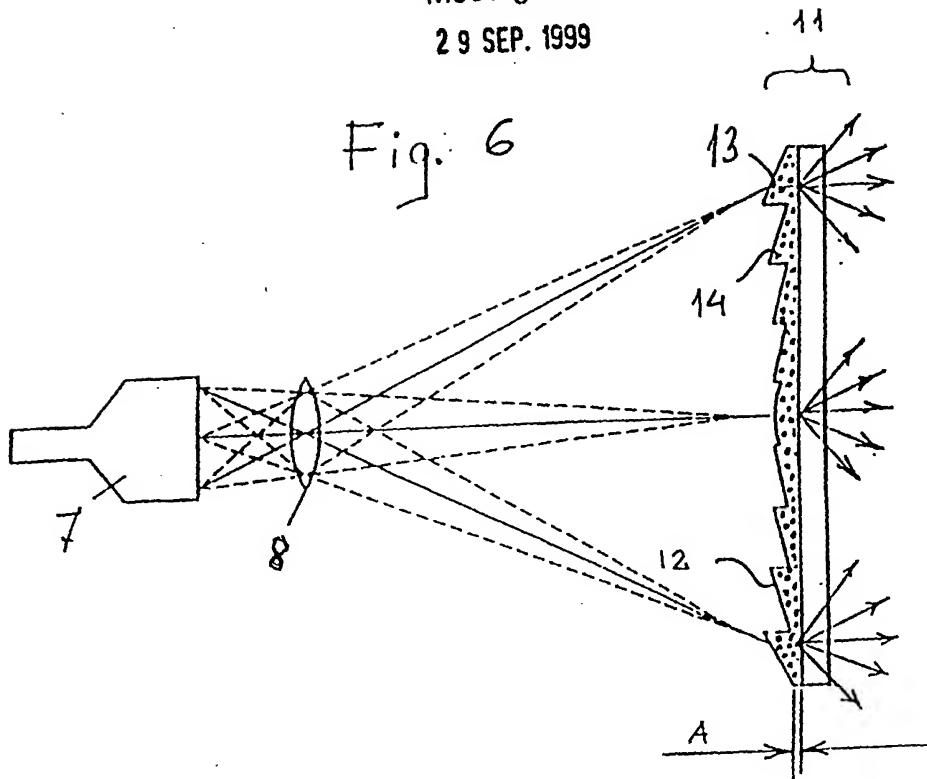


Fig. 7

